



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/624,564	07/23/2003	Shuji Hirao	60188-594	6629

7590 05/09/2006

Jack Q. Lever, Jr.  
McDERMOTT, WILL & EMERY  
600 Thirteenth Street, N.W.  
Washington, DC 20005-3096

EXAMINER

WONG, EDNA

ART UNIT PAPER NUMBER

1753

DATE MAILED: 05/09/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

10/624,564

Applicant(s)

HIRAO, SHUJI

Examiner

Edna Wong

Art Unit

1753

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 24 April 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-30 is/are pending in the application.
- 4a) Of the above claim(s) 12-30 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-11 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 23 July 2003 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
- 1) ☒ Certified copies of the priority documents have been received.
  - 2) ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - 3) ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>See "Other"</u> . | 6) <input checked="" type="checkbox"/> Other: <u>See Continuation Sheet</u> .           |

Continuation of Attachment(s) 6). Other: July 23, 2003 and January 25, 2005.

### ***Election/Restrictions***

Applicant's election of Group I, claims 1-11, in the reply filed on April 24, 2006 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)).

Accordingly, claims 12-30 are withdrawn from consideration as being directed to a non-elected invention.

### ***Drawings***

Figure 9 should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). Corrected drawings in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Applicant's specification discloses "the conventional structure shown in FIG. 9" (page 28, line 9).

***Specification***

The disclosure is objected to because of the following informalities:

page 1, line 20, the words -- (not shown) -- should be inserted after the number "17".

page 10, line 2, the words -- (not shown) -- should be inserted after the number "153".

page 13, line 22, the words -- (not shown) -- should be inserted after the number "113".

page 26, line 25, reference character "210a" has been used to designate both a seal and a cathode electrode (from page 26, line 24). It is unclear what reference character "210a" designates.

Appropriate correction is required.

The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

***Claim Rejections - 35 USC § 112***

I. Claims 1-11 are rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for electroplating, does not reasonably provide enablement for chemical vapor deposition, physical vapor deposition and electroless plating. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to use the invention commensurate in scope with these claims.

Claim 1, line 8, recites “the plating process”. The plating process is open to chemical vapor deposition, physical vapor deposition and electroless plating. However, Applicant’s specification discloses that “the present invention relates to a method and apparatus for plating a substrate, and more particularly, to a technology for forming wiring and the like by electrolytic plating” (page 1, lines 3-4), and Embodiments 1-5 (pages 7-31) all recited applying a voltage (plating current). Thus, “the plating process” as presently claimed is not commensurate in scope with Applicant’s specification.

II. Claims 1-11 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

**Claim 1**

lines 2-3, recite “facing a surface of the substrate to be plated downward and immersing the substrate in a plating solution” in the preamble. It is unclear if these are

actual method steps.

Claim 9

lines 3-5, recite "Prior to the step of removing the bubble, the step of: performing the plating process with respect to the substrate in the plating solution until at least the one of depressed portions provided in the surface to be plated having a minimum diameter is filled up". Is the plating process performed twice - prior to and after the step of removing the bubble?

line 4, "the one of depressed portions" lacks antecedent basis.

***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims **1 and 3-5** are rejected under 35 U.S.C. 102(b) as being anticipated by **JP 2001-316869 ('869)**.

JP '869 teaches a method for plating a substrate through a plating process (= electrolytic plating) performed with respect to the substrate **W** (= semiconductor wafer) by facing a surface of the substrate to be plated downward and immersing the substrate

in a plating solution 11 (= plating liquid) [page 4, [0015]; and Fig. 1(a)], the method comprising the steps of:

(a) rotating the substrate in the plating solution at a first speed of rotation (= 20-60 rpm) and thereby removing a bubble adsorbed to the substrate (pages 5-6, [0023]); and after the step of removing the bubble,

(b) rotating the substrate in the plating solution at a second speed of rotation (= 30 rpm) lower than the first speed of rotation and thereby performing the plating process with respect to the substrate (pages 6-7, [0028]).

The second speed of rotation is not less than 10 rpm and not more than 60 rpm (= 30 rpm) [pages 6-7, [0028]].

A current density applied to the substrate in the step of removing the bubble is lower than a current density applied to the substrate in the step of performing the plating process with respect to the substrate (= termination of the purge of air bubbles was checked by the resistance value changed by the minute current which impressed the semiconductor wafer when immersed) [page 7, [0028]].

The method further comprises prior to the step of removing the bubble, the step of: forming a seed layer on the surface of the substrate to be plated, wherein the step of removing the bubble includes the step of preventing the seed layer from being dissolved in the plating solution (= a certain amount of rotational speed was needed for driving out the air bubbles. When the rotational speed of a supporter was too slow, it turned out that the seed layer of the semiconductor wafer begins to melt into the plating liquid



(pages 2-3, [0010]). The invention was made based on the above-mentioned knowledge (page 3, [0011])).

The substrate **W** is held in the plating solution **11** by a substrate holding mechanism **18** (= supporter) having an electrode **17** (= a cathode) for contacting the surface to be plated (page 4, [0015]; and Fig. 1(b)) and a seal **23** for contacting the surface to be plated in such a manner as to protect the electrode from the plating solution (page 5, [0018]-[0019]; and Fig. 1(b)).

Since JP '869 teaches all of the limitations recited in the instant claims, the reference is deemed anticipatory.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

I. Claims **2 and 11** are rejected under 35 U.S.C. 103(a) as being unpatentable over **JP 2001-316869** ('869) as applied to claims 1 and 3-5 above, and further in view of **Reid et al.** (US Patent No. 6,551,487 B1).

JP '869 is as applied above and incorporated herein.

The method of JP '869 differs from the instant invention because JP '869 does not disclose the following:

a. Wherein the first speed of rotation is not less than 100 rpm and not more than 200 rpm, as recited in claim 2.

b. Prior to the step of removing the bubble, immersing the substrate in the plating solution, while rotating the substrate at the first speed of rotation or at a third speed of rotation higher than the second speed of rotation, as recited in claim 11.

JP '869 teaches that the first speed of rotation is 20-60 rpm (page 5, [0023]).

Like JP '869, Reid teaches a method for plating a substrate through a plating process (= electroplating) performed with respect to the substrate **240** (= wafer) by facing a surface of the substrate to be plated downward and immersing the substrate in a plating solution **244** (= electrolyte) [col. 9, lines 11-18; and Fig. 2E]. The substrate **240** is immersed in the plating solution **244**, while rotating the substrate at the first speed of rotation (= between about 1 and 150 rpm) [col. 8, line 66 to col. 9, line 18; and Figs. 2D-2E]. The first rotational speed for immersing the wafer is preferably between about 50 and 100 rpm when the wafer for a 300 mm diameter wafer (col. 6, lines 35-50; and col. 8, line 66 to col. 9, line 10).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the first speed of rotation described by JP '869 with wherein the first speed of rotation is not less than 100 rpm and not more than 200 rpm; and prior to the step of removing the bubble, immersing the substrate in the plating solution, while rotating the substrate at the first speed of rotation or at a third speed of rotation higher than the second speed of rotation because if wafer rotation and

immersion rate (z speed) are properly controlled, multiple wetting fronts and bubble formation (frothing) during immersion can be minimized as taught by Reid (col. 8, line 66 to col. 9, line 10).

Furthermore, the first speed of rotation is a result-effective variable and one skilled in the art has the skill to calculate the first speed of rotation that would have determined the success of the desired reaction to occur, e.g., the wafer is rotated between about 50 and 100 rpm when the wafer is a 300 mm diameter wafer, absent evidence to the contrary. MPEP § 2141.03 and § 2144.05(II)(B).

II. Claims 6 and 9-10 are is rejected under 35 U.S.C. 103(a) as being unpatentable over JP 2001-316869 ('869) as applied to claims 1 and 3-5 above, and further in view of Applicant's admitted prior art (specification, "Background of the Invention", page 2, lines 6-12; page 3, line 10 to page 4, line 4; and Figs. 10A-10B and 13A-13B).

JP '869 is as applied above and incorporated herein.

The method of JP '869 differs from the instant invention because JP '869 does not disclose the following:

a. Wherein the bubble has a size of 10  $\mu\text{m}$  or less, as recited in claim 6.

Applicant discloses that when the semiconductor substrate is brought into contact with the plating solution, extremely small bubbles each having a size of about several micrometers or less are adsorbed to the surface to be plated (specification, page 2, lines 6-8).

The invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made because when the semiconductor substrate is brought into contact with the plating solution, extremely small bubbles each having a size of about several micrometers or less are adsorbed to the surface to be plated as taught Applicant (specification, page 2, lines 6-8).

b. Prior to the step of removing the bubble, the step of: performing the plating process with respect to the substrate in the plating solution until at least the one of depressed portions provided in the surface to be plated having a minimum diameter is filled up, as recited in claim 9.

Applicant discloses that the residues of the TaN film **59a** and the Cu film **59b** resulting from the polishing of wiring material are filled also in the depression **57** to form a conductive portion **59** (specification, page 3, line 24 to page 4, line 1).

The invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made because a depression resulting from a pit defect or the like are conventionally encountered in the art and the residues of a TaN film and a Cu film resulting from the polishing of wiring material are filled also in the depression to form a conductive portion as taught by Applicant (specification, page 3, line 24 to page 4, line 1).

c. Wherein a thickness of a plate film necessary to fill up the depressed

portion having the minimum diameter is 20% or less of a target thickness of the plate film, as recited in claim 10.

Applicant shows a depression **57** smaller than the trench below it (Fig. 13B).

The invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made because since the depression is smaller than the trench, the thickness of a plate film necessary to fill up the depressed portion having the minimum diameter would have been 20% or less of a target thickness of the plate film, depending upon how much smaller the depression was from the trench.

III. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over **JP 2001-316869** ('869) as applied to claims 1 and 3-5 above, and further in view of **Batz, Jr. et al.** (US Patent No. 6,001,234).

JP '869 is as applied above and incorporated herein.

The method of JP '869 differs from the instant invention because JP '869 does not disclose wherein a contact angle of the seal relative to the surface to be plated is not less than 120° and not more than 150°, as recited in claim 7.

JP '869 teaches a seal **23** for contacting the surface to be plated in such a manner as to protect the electrode **17** from the plating solution (page 5, [0018]-[0019]; and Fig. 1(b)).

Like JP '869, Batz, Jr. teaches electroplating a wafer. Batz, Jr. teaches a seal **868** for contacting the surface **W** to be plated in such a manner as to protect the

electrode **858** from the plating solution (col. 22, line 65 to col. 23, line 41; and Fig. 22).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the seal described by JP '869 with wherein a contact angle of the seal relative to the surface to be plated is not less than 120° and not more than 150° because the substitution of a known material based on its suitability for its intended use supported a *prima facie* obviousness determination (MPEP § 2144.07).

**IV.** Claim **8** is rejected under 35 U.S.C. 103(a) as being unpatentable over **JP 2001-316869** ('869) as applied to claims 1 and 3-5 above, and further in view of **Wang et al.** (US Patent No. 6,610,189 B2).

JP '869 is as applied above and incorporated herein.

The method of JP '869 differs from the instant invention because JP '869 does not disclose wherein the step of removing the bubble includes the step of applying supersonic vibration to the plating solution, as recited in claim 8.

Like JP '869, Wang teaches electroplating a wafer. Wang teaches that mechanically vibrating the electrolyte solution mechanically enhances the concentration of metal ions in the electrolyte solution in the features (col. 13, line 62 to col. 14, line 19).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the step of removing the bubble described by JP

'869 with wherein the step of removing the bubble includes the step of applying supersonic vibration to the plating solution because this would have mechanically enhances the concentration of metal ions in the electrolyte solution in the features as taught by Wang (col. 13, line 62 to col. 14, line 19).

Furthermore, the reason or motivation to modify the reference may often suggest what the inventor has done, but for a different purpose or to solve a different problem. It is not necessary that the prior art suggest the combination to achieve the same advantage or result discovered by the Applicants. *In re Linter* 458 F.2d 1013, 173 USPQ 560 (CCPA 1972); *In re Dillon* 919 F.2d 688, 16 USPQ2d 1897 (Fed. Cir. 1990), *cert. denied*, 500 US 904 (1991); and MPEP § 2144.

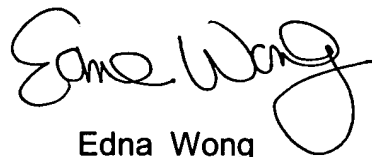
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Edna Wong whose telephone number is (571) 272-1349. The examiner can normally be reached on Mon-Fri 7:30 am to 4:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (571) 272-1342. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only.

Art Unit: 1753

For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to read "Edna Wong". The signature is fluid and cursive, with the first name "Edna" and last name "Wong" clearly distinguishable.

Edna Wong  
Primary Examiner  
Art Unit 1753

EW  
May 4, 2006